2.6 Wetlands, Riparian Areas, and Vegetated Treatment Systems

Wetlands, Riparian Areas, and Vegetated Treatment Systems Category Links:

- ➔ Protection of Wetlands and Riparian Areas
- ➔ Restoration of Wetlands and Riparian Areas
- ➔ Vegetated Treatment Systems
- ➔ Education/Outreach

2.6.1 Introduction

2.6.1.1 Background

The State Water Resources Control Board (SWRCB) and California Coastal Commission (CCC) have identified four management measures to protect and restore wetlands and riparian areas, and encourage the use of vegetated treatment systems as a means to control nonpoint sources of pollution. The purposes of these management measures are to promote and maintain the water quality benefits of wetland and riparian areas and to ensure that degradation does not result in nonpoint source (NPS) pollution. Associated with each management measure are management practices that are designed to promote conservation and restoration of wetlands, and reduce the quantities of pollutants entering receiving waters. The fact sheet prepared for each management measure informs readers of the programs, information resources, and case studies specific to California and the management measure.

Wetlands are vital to the survival of aquatic and terrestrial wildlife and plants. They play an important role in filtering out pollutants, preventing soil erosion, providing flow control, surface and ground water storage, aquatic and semiaquatic habitat, biological diversity, and recreation (California Resources Agency, 1998). In California, only 10 percent of the wetlands that existed prior to European settlement remain intact and only 5 percent of the coastal wetlands remain intact (California Resources Agency, 1998). Changes in hydrology, geochemistry, substrate, or species composition can impair wetland and riparian areas and reduce their ability to filter out pollutants in runoff, which can result in poor water quality in the receiving waters. Activities such as highway construction, deposition of dredged material, draining wetlands for development or cropland, hydromodification, and excavation of ports and marinas can all cause impairment of wetlands and riparian areas (USEPA, 2001).

The *Plan for California's Nonpoint Source Pollution Control Program, Volume II: California's Management Measures for Polluted Runoff* (SWRCB and CCC, 2000) defines the four management measures for wetlands, riparian areas, and vegetated treatment systems as follows:

- **6A. Protection of Wetlands and Riparian Areas**. Implementation of this management measure is intended to protect the existing water quality improvement functions of wetlands and riparian areas as a component of NPS programs.

- **6B. Restoration of Wetlands and Riparian Areas**. Restoration of wetlands and riparian areas refers to the recovery of a range of functions that existed previously by reestablishing hydrology, vegetation, and structure characteristics. Damaged or destroyed wetland and riparian areas should be restored where restoration of such systems will significantly abate polluted runoff.

- **6C. Vegetated Treatment Systems**. This management measure promotes the installation of vegetated treatment systems (e.g., artificial or constructed wetlands) in areas where these systems will serve a polluted runoff-abatement function. Vegetated filter strips and engineered wetlands remove sediment and other pollutants from runoff and wastewater, and prevent pollutants from entering adjacent water bodies. Removal typically occurs through filtration, deposition, infiltration, absorption, adsorption, decomposition, and volatilization.

- **6D. Education and Outreach**. This management measure promotes the establishment of programs to develop and disseminate scientific information on wetlands and riparian areas and to develop greater public and agency staff understanding of natural hydrologic systems—including their functions and values, how they are lost, and the choices associated with their protection and restoration.

2.6.2 General Resources

There are several federal programs that can provide general information to promote the protection and restoration of wetlands and riparian areas and assist with the implementation of the four management measures. The agencies and programs listed below can provide assistance and information for each wetland, riparian, and vegetated treatment system management measure. Resources specific to each of the four management measures can be found on the corresponding fact sheet.

- **California Coastal Commission's Local Assistance Program, Links to Wetlands Sites Web page** (http://www.coastal.ca.gov/la/wetland_links.html): This is a page of Web links related to wetlands management in California and nationally.

- **California Resources Agency, California Wetlands Information System** (http://ceres.ca.gov/wetlands/): This system is a compilation of public and private sector information, including maps, environmental documents, agency roles in wetlands management, restoration and mitigation activities, regulatory permitting, and wetland policies. It is designed to provide comprehensive wetlands information to the general public, the educational community, and government agencies.

- **Coastal Conservancy and California Coastal Commission, Southern California Coastal Wetlands Inventory** (http://www.ceres.ca.gov/wetlands/geo_info/so_cal.html): The inventory consists of a database of existing information on 41 coastal wetlands that lie between Mexico and Point Conception in northern Santa Barbara County. It provides three types of information for each site: (1) a map of the wetland's historical extent, (2) a map of recent habitat distributions, and (3) a "profile" that briefly describes ecological conditions and land use and enhancement histories.

- **California Resources Agency, California Wetlands** (http://ceres.ca.gov/ceres/calweb/wetlands.html): This site contains excerpts from the Water Plan Update and a series of links to wetlands- and water resource-related Web pages.

- **Pacific Estuary Research Laboratory** (http://www.sci.sdsu.edu/PERL): The Pacific Estuary Research Laboratory was created in 1984 with funding from NOAA's Office of Coastal Zone Management, the California State Resources Agency, California State Coastal Conservancy, and San Diego State University. The site offers such resources as water quality-related reports and data, A Manual for Assessing Restored and Natural Coastal Wetlands, and other tools related to wetlands management.

- **Natural Resource Projects Inventory (NRPI)** (http://endeavor.des.ucdavis.edu/nrpi/): NRPI is a searchable comprehensive electronic database with information on thousands of conservation, mitigation and restoration projects being developed and implemented throughout California. It was developed as a collaborative effort between the California Biodiversity Council and the University of California at Davis Information Center for the Environment.

- **Water Resources Center Archives, Internet Resources** (http://www.lib.berkeley.edu/WRCA/internet.html): This Web page is a clearinghouse for links related to water resource management and historical water resource data in California. The links are organized by topic and include Topic: "Coastal, Estuarine, Ocean," "Restoration," "Rivers, Lakes, Creeks," and others.

- **San Francisco Bay Area Wetland Project Tracker** (http://www.wrmp.org/projectsintro.html): The Wetland Project Tracker provides free public access to information about the location, size, sponsors, habitats, contact persons, and status of wetland restoration, mitigation, creation, and enhancement projects in the San Francisco Bay Area.

- **Watershed Institute** (http://watershed.csumb.edu/): The Watershed Institute consists of a direct action community-based coalition of researchers, restoration ecologist, educators, planners, students, and volunteers. The Web site offers links to watershed-related publications, courses, watershed studies, the Return of the Natives Restoration Education Project, and the Bureau of Land Management's Watershed and Riparian Assessment Report.

- **USEPA Wetlands Program** (http://www.epa.gov/owow/wetlands/): This program encourages and enables others to act effectively in protecting and restoring the nation's wetlands and associated ecosystems, including shallow open waters and free-flowing streams. In doing so, the program engages in two principal categories of activities—establishing national standards and assisting others to meet them.

- **U.S. Army Corps of Engineers (USACE) Regulatory Program** (http://www.usace.army.mil/inet/functions/cw/cecwo/reg/): This Web site acts as a starting point for information about USACE's wetlands regulatory program and offers policy and guidance related to wetland management. The site provides links to laws and regulations governing activities that can impact wetlands, policy documents, jurisdictional information, and technical guidance for delineation, management, and mitigation.

- **U.S. Geological Survey National Wetlands Research Center (NWRC)** (http://www.nwrc.usgs.gov/): The Center develops and disseminates scientific information needed for understanding the ecology and values of wetlands and for managing and restoring wetland habitats and associated plant and animal communities.

- **U.S. Department of Agriculture Natural Resources Conservation Service, Wetlands Science Institute** (http://www.pwrc.usgs.gov/WLI/): The Institute develops, adapts, and disseminates science and technology needed to protect and restore wetlands. The "Oxford Site Home Page" link provides information on and photos of constructed wetlands, along with hydrology tools, restoration information, and links to papers, fact sheets, and posters.

- **San Francisco Estuary Institute (SFEI)** (http://www.sfei.org/index.html): Among its research efforts, SFEI works with local and regional stakeholders to assess wetland science and monitoring in the San Francisco Estuary. SFEI strives to enhance coordination of research in this area and seeks to implement of a regional program to monitor the status and trends of the wetland ecosystem of this estuary. SFEI has recently started a biannual newsletter of mercury research and activities underway in the Bay-Delta region (October 2004 issue: http://www.sfei.org/rmp/mercury_newsletter/HgNews10_06_04.htm). The purpose of the newsletter is to inform scientists, regulators, and stakeholders of recent completed and on-going mercury research activities and to foster collaboration and discussion among these groups. This electronic newsletter will be issued bi-annually and is intended to be a compilation of mercury

research activities currently underway in the Bay Area. On-going projects include "Concentration and Production of Methylmercury in Wetlands in the Bay" and "Wetland Design and Management Options for Control of Hg in SF Bay." SFEI also sponsors a Web site with information on the detection of exotic species, which can be accessed at http://exoticsguide.org/.

- **Clean Water Act Section 401 Certification Program** (http://www.swrcb.ca.gov/cwa401/index.html): Through the Clean Water Act (CWA) section 401 certification program, Regional Water Quality Control Boards (RWQCBs) review projects that require a federal permit under CWA section 404 or that involve dredge or fill activities that may result in a discharge to waters of the United States. This is to ensure that the State's interests are protected on any federally permitted activity occurring in or adjacent to waters of the State. Detailed information about CWA section 401 in California, including a description of the program, resources, legal background information, proposed projects, and links, are described on the SWRCB Web site.

- **USEPA, Nonpoint Source News-Notes** (http://www.epa.gov/owow/info/NewsNotes/): Nonpoint Source News-Notes is an online bulletin published by EPA that covers a wide range of topics, including nonpoint source pollution control, watershed restoration, and ecosystem-driven management. The Web interface allows users to search current and back issues of News-Notes by keyword.

- **USEPA *National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution*** (http://epa.gov/owow/nps/wetmeasures/): USEPA published this technical guidance and reference document to assist nonpoint source managers and the public in the implementation of nonpoint source pollution management programs. It contains information on the best available, economically achievable means of reducing nonpoint source pollution through the protection and restoration of wetlands and riparian areas, as well as the implementation of vegetated treatment systems. Topics covered include an overview of wetlands, riparian areas, and vegetated treatment systems; techniques for the protection and restoration of wetlands and riparian areas; and management measures for vegetated treatment systems. The appendix includes a list of financial and technical assistance programs, government contacts, and an index of case studies.

- **NatureServe *Biodiversity Values of Geographically Isolated Wetlands in the United States*** (http://www.natureserve.org/publications/isolatedwetlands.jsp): This report discusses some of the implications of the 2001 Supreme Court decision *SWANCC vs. the U.S. Army Corps of Engineers*, which states that some wetlands and other waters that are considered "geographically isolated" from navigable waters do not fall under the jurisdiction of the Clean Water Act. Included in the report is an analysis of wetland ecosystems that can be interpreted to be "geographically isolated" and the types and numbers of at-risk species and plant communities that these habitats support. The full report can be downloaded in PDF format, and several appendices also are available that summarize methodologies and data used in the analysis, including standards for ecological classification, dichotomous keys to and descriptions of geographically isolated wetlands in the U.S., at-risk animal and plan species tied to isolated wetland ecological systems, and area-weighted counts of at-risk species by county, among others.

- **Center for Watershed Protection Wetlands Web site** (http://www.cwp.org/wetlands/index.htm): The Center for Watershed Protection has assembled a Web site as a central source for information on wetland protection information. The site includes articles from the Center's "Wetlands and Watersheds Article Series, Web links, an events calendar, glossary, and other resources.

2.6.2.1 References

California Resources Agency. 1998. *California Wetlands Information System: California's Valuable Wetlands*. (http://ceres.ca.gov/wetlands/introduction/values.html) Last updated August 13, 1998. Accessed July 15, 2003.

SWRCB and CCC. 2000. *Volume II: California's Management Measures for Polluted Runoff (CAMMPR)*. State Water Resources Control Board and the California Coastal Commission, Sacramento, CA.

USEPA. 2001. Chapter 4: Management Measure for Protection of Wetlands and Riparian Areas. In *National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution (Draft)*. EPA 841-B-01-001. U.S. Environmental Protection Agency, Washington, DC.

Fact Sheet Links:

- Programs
- Management Practices
- Information Resources
- Case Studies
- References

2.6.3 Management Measure 6A Protection of Wetlands and Riparian Areas

Management Measure

Protect from adverse effects wetlands and riparian areas that serve to reduce NPS pollution; maintain this function while protecting the other existing functions of these wetlands and riparian areas as measured by characteristics such as vegetative species composition, diversity, and cover; hydrology and quality of surface water and ground water; geochemistry of the substrate; and fauna species composition, diversity, and abundance.

2.6.3.1 Programs

The California Resources Agency is responsible for the implementation of the State Wetlands Conservation Policy. The policy has three main goals: (1) no net loss of wetlands and a net gain of wetlands, (2) reduction in the complexity of wetland conservation laws and regulations, and (3) implementation of landowner incentive programs and cooperative planning programs. The program is divided into three geographic areas: Central Valley, San Francisco Bay, and Southern California (http://ceres.ca.gov/wetlands/policies/governor.html).

Central Valley Joint Venture (CVJV) was established in 1988 to "protect, maintain, and restore habitat to increase waterfowl populations to desired levels in the Central Valley of California consistent with other objectives of the North American Waterfowl Management Plan." An Implementation Board of representatives from the California Waterfowl Association, Defenders of Wildlife, Ducks Unlimited, National Audubon Society, Waterfowl Habitat Owners Alliance, and The Nature Conservancy guides the CVJV. The U.S. Fish and Wildlife Service, California Department of Fish and Game, California Department of Food and Agriculture, and other organizations and agencies provide technical assistance and advice to the Board (http://www.centralvalleyjointventure.org).

San Francisco Bay Conservation and Development Commission is charged with the protection and enhancement of San Francisco Bay. Protecting the Suisun Marsh and other wetlands around the bay is one of the responsibilities of the Commission (http://www.bcdc.ca.gov/index.php).

Inland Wetlands Conservation Program carries out some of the Central Valley Joint Venture objectives by administering a $2-million-per-year program to acquire, improve, buy, sell, or lease wetland habitat (http://www.wcb.ca.gov/Pages/inland_wetlands_conservation_program.htm).

CALFED Bay-Delta Program develops and implements a long-term comprehensive plan to restore ecological health and improve water management for beneficial uses of the Bay-Delta System (http://www.calwater.ca.gov/).

Riparian Habitat Joint Venture (RHJV) has as its goal to conserve, increase, and improve riparian habitat to protect and enhance California's native resident birds and neotropical migratory birds. California Partners in Flight initiated the RHJV project in 1994. To date, 18 federal, state, and private organizations have signed the landmark Cooperative Agreement to protect and enhance habitats for native land birds throughout California (http://www.prbo.org/calpif/htmldocs/rhjv/).

California SWRCB has issued *Statewide General Waste Discharge Requirements for Dredged or Fill Discharges to Waters Deemed by the U.S. Army Corps of Engineers to be Outside of Federal Jurisdiction (General WDRs)* (http://www.swrcb.ca.gov/resdec/wqorders/2004/wqo/wqo2004-0004.pdf). The General Waste Discharge Requirements are limited to dredge or fill discharge activities not covered under federal jurisdiction of CWA section 401 certification program. Wetlands, riparian areas, and headwaters that are not classified as waters of the United States are included in the waters covered under the General WDRs to continue the State's "No Net Loss" Policy for wetlands. Further information about California's WDRs is available online (http://www.swrcb.ca.gov/cwa401/).

2.6.3.2 Management Practices

The purpose of this management measure is to protect the water quality improvement and NPS pollution reduction benefits derived from wetlands and riparian areas. Wetlands are characterized by a combination of standing water at the surface or root zone, unique soil conditions, and vegetation adapted to wet conditions (Mitsch and Gosselink, 1993). This management measure should combine structural and programmatic measures to protect wetland and riparian areas so that they maintain their existing functions. Recommended measures and practices include the following:

- Consider wetlands and riparian areas and their NPS control potential on a watershed or landscape and maintain their function as part of a continuum of filters along rivers, streams, and coastal waters.
- Identify existing functions of those wetlands and riparian areas with significant NPS control potential when implementing NPS management practices. Do not alter wetlands or riparian areas to improve their water quality function at the expense of their other functions.
- Do not place surface water runoff ponds or sediment retention basins in healthy wetland systems.
- Conduct permitting, licensing, certification, and nonregulatory NPS pollution abatement activities in a manner that protects wetland functions.
- Obtain easements or full acquisition rights for wetlands and riparian areas along streams, bays, and estuaries.
- Use zoning and protective ordinances to control activities that have an adverse impact on these targeted areas through special area zoning and transferable development rights.
- Ensure that State water quality standards apply to wetlands.
- Establish, maintain, and strengthen regulatory and enforcement programs.
- Encourage the use of programs that restore wetlands and riparian areas.
- Educate landowners and agencies on the role of wetlands and riparian areas in protecting water quality and on management practices for restoring stream edges.
- Provide a mechanism for private landowners and agencies in mixed ownership watersheds to develop, by consensus, goals, management plans, and appropriate practices and to obtain assistance from federal and State agencies.

- Use appropriate pretreatment practices such as vegetated treatment systems or detention or retention basins to prevent adverse impacts on wetland functions that affect the abatement of NPS pollution from hydrologic changes, sedimentation, or contaminants.

- Reduce erosion and, to the extent practicable, retain sediment onsite during and after construction.

2.6.3.3 Information Resources

- ***Options for Wetland Conservation: A Guide for California Land Owners*** (http://www.ceres.ca.gov/wetlands/introduction/opt_guide.html): This guide describes a wide variety of approaches that have been devised to assist landowners in protecting wetlands according to their different needs, within the context of broader conservation goals. The array of options includes technical information and advice, and financial contributions for projects or practices that provide long-term improvements for wetland values. To obtain a copy, contact the California State Coastal Conservancy, 1330 Broadway Street, Suite 1100, Oakland, CA 94612 (Telephone: 510-286-1015; Fax: 510-286-0470).

- ***The Oregon Wetlands Conservation Guide: Voluntary Wetlands Stewardship Options for Oregon's Private Landowners***: To obtain a copy of this guide, contact the Oregon Department of Agriculture, Natural Resources Division (Telephone: 503-292-9451).

- **California Wetlands Information System** (http://ceres.ca.gov/wetlands/): This Wetlands Information System is designed to provide comprehensive wetlands information to the general public, the educational community, and government agencies. It is a compilation of public and private sector information, including maps, environmental documents, agency roles in wetland management, restoration and mitigation activities, regulatory permitting, and wetland policies. It also includes a wetland database and inventory.

- **Izaak Walton League, *Handbook for Wetland Conservation and Sustainability*** (http://www.iwla.org/sos/handbook/): The Izaak Walton League put together this handbook to assist communities with planning and implementing a wetland project. The book features guidelines and tips for an effective project, monitoring techniques, case studies of other restoration projects, and extensive lists of contacts and resources.

- ***Managing Wetlands to Control Nonpoint Source Pollution*** (http://www.epa.gov/owow/nps/facts/point11.htm): This USEPA fact sheet, Nonpoint Pointer Number 11, includes information on the use of wetlands to control NPS pollution.

- **California Resources Agency, Department of Fish and Game, *Report to Legislature, California Wetland Mitigation Banking*** (http://www.dfg.ca.gov/hcpb/conplan/mitbank/WetlandsBank Leg Report Final.pdf): This is a report to California State Congress on the progress of wetland mitigation banking in California.

- **Save San Francisco Bay Association, Save The Bay Web Site** (http://www.savesfbay.org/): Save The Bay (Save San Francisco Bay Association) seeks to preserve, restore, and protect the San Francisco Bay and Sacramento/San Joaquin Delta Estuary as healthy and biologically diverse ecosystems essential to the well-being of the human and natural communities they sustain.

- **National Research Council, Compensating for Wetland Losses under the Clean Water Act** (http://books.nap.edu/books/0309074320/html/index.html): This document provides information on wetland mitigation and permitting guidelines, wetland restoration case studies, and analyses of soil, plant, and animal communities for mitigation sites. The document is available for browsing in HTML format or printing as a PDF file.

- **Ramsar Convention on Wetlands, *Economic Valuation of Wetlands on the River Basin Scale*** (http://www.ramsar.org/features/features_econ_val1.htm): This discussion paper addresses topics such as why it is important to estimate ecosystem value, the relationship between ecology and economics, identifying and quantifying wetland values, and using cost-benefit analysis as a tool for decision making.

2.6.3.4 Case Studies

The Los Osos Creek Wetland Reserve. This 144-acre site is located on Los Osos Creek, just upstream of the Morro Bay estuary. The USDA Natural Resources Conservation Service and the Coastal San Luis Resource Conservation District (CSLRCD) have purchased permanent wetland reserve easements on the property. The State Coastal Conservancy provided funding for the CSLRCD easement. The easements were acquired to return 111 acres to floodplain and riparian habitat, which will serve as a sediment deposition area, trapping sediment before it enters Morro Bay. Thirty-three acres are permanently protected in an agricultural easement. Because this is still private property, there is no public access to the site (http://www.coastalrcd.org/).

Use of Riparian Corridors and Vineyards by Mammalian Predators in Northern California. Researchers examined the how mammalian predators use riparian corridors in Northern California to illustrate how wildlife prefer to travel in riparian corridors rather than in developed areas. The study also examined how other aspects of riparian buffers such as buffer width can be a factor in use by predators. The study concludes that riparian buffers can provide benefits to stream systems as well as to conservation of native wildlife populations (Hilty and Merenlender, 2004).

2.6.3.5 References

California Resources Agency. 1998. *California Wetlands Information System: California's Valuable Wetlands*. (http://ceres.ca.gov/wetlands/introduction/values.html) Last updated August 13, 1998. Accessed July 15, 2003.

Hilty, J.A., and A.M. Merenlender. 2004. Use of riparian corridors and vineyards by mammalian predators in Northern California. *Conservation Biology* 18(1): 126–135.

Mitsch, W., and J. Gosselink. 1993. *Wetlands.* Second Edition. Van Nostrand Reinhold, New York, NY.

USEPA. 2001. Chapter 4: Management Measure for Protection of Wetlands and Riparian Areas. In *National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution (Draft)*. EPA 841-B-01-001. U.S. Environmental Protection Agency, Washington, DC.

Fact Sheet Links:
- Programs
- Management Practices
- Information Resources
- Case Studies
- References

2.6.4 Management Measure 6B Restoration of Wetlands and Riparian Areas

Management Measure

Promote the restoration of the preexisting functions in damaged and destroyed wetlands and riparian systems in areas where the systems will serve to reduce NPS pollution.

2.6.4.1 Programs

The Southern California Wetlands Recovery Project is a partnership of public agencies working cooperatively to acquire, restore, and enhance coastal wetlands and watersheds between Point Conception and the international border with Mexico. They are also building a dynamic information system, called the Wetlands Recovery Project, to help collect and distribute data, resources, and other information on Southern California's coastal wetlands and coastal watersheds ((http://www.coastalconservancy.ca.gov/scwrp/)

The San Francisco Bay Joint Venture (SFBJV) is a partnership that brings together public and private agencies, conservation groups, development interests, and others seeking to collaborate in restoring wetlands and wildlife habitat specifically within the San Francisco Bay watersheds and along the San Mateo Coast (http://www.sfbayjv.org/).

CALFED Bay-Delta Program ecosystem restoration actions under the CALFED Bay-Delta Program help restore and improve the health of the Bay-Delta system for all native species while reducing its water management constraints (http://calwater.ca.gov/Programs/EcosystemRestoration/Ecosystem.asp).

U.S. Department of Agriculture Natural Resources Conservation Service (USDA NRCS), California Wetlands Reserve Program has focused on the restoration of a variety of wetland types throughout the State, including seasonal wetlands, semi-permanent marsh, vernal pools along the perimeter of the Central Valley, riparian corridors, and tidally influenced wetlands (http://www.nrcs.usda.gov/programs/wrp/states/ca.html).

California Department of Transportation (Caltrans) abides by the no-net loss requirement for California wetlands and is responsible for creating, restoring, or enhancing wetlands or riparian areas damaged or destroyed by highway projects (http://www.dot.ca.gov/hq/env/bio/index.htm).

Ballona Wetlands Foundation was created by a court action to preserve and protect the remaining Ballona Wetlands on California's coast near Los Angeles. The foundation is responsible for implementing and managing a comprehensive restoration plan for the wetlands (http://www.ballona-wetlands.org/).

2.6.4.2 Management Practices

The purpose of this management measure is to promote the restoration of degraded or destroyed wetlands in areas where they can reduce NPS pollution. Restoration of a wetland and a riparian area means reestablishing the existing vegetation, hydrology, and structure characteristics. This management measure should be used in conjunction with other measures addressing the adjacent land use activities, like agriculture, urban areas, marinas, and forestry. Recommended practices and measures for promoting the restoration of riparian areas and wetlands include the following:

- Provide a hydrologic regime similar to that of the type of wetland or riparian area being restored.
- Identify important information such as site history, topography, tides, existing water control structures, hydrology, sediment budgets, soil, plants, salinity, timing of the restoration project, and potential impacts from adjacent human activities, before beginning a restoration project.
- Restore native plant species through either natural succession or selected planting.
- Plant a diversity of species or manage the natural succession of diverse plant species rather than planting monocultures.
- Plan restoration as part of naturally occurring aquatic ecosystems.
- Factor in ecological principles when selecting sites and designing restoration. Consider type and quantity of pollutant, slope, and vegetated area.

2.6.4.3 Information Resources

- ***Stream Corridor Restoration*** (http://www.nrcs.usda.gov/technical/stream_restoration/): This document was produced by the collective experience, skills, and technology of 15 federal agencies. It is a benchmark document that is being used by these agencies, as well as many others who are interested in restoring the functions and values of the nation's stream corridors.
- **Caltrans, *Standard Environmental Reference*, Chapter 5: Mitigation and Monitoring** (http://www.dot.ca.gov/ser/vol3/chap5.htm): This chapter provides guidance on mitigation activities used to compensate for the loss of wetlands due to transportation activities.
- **Tennessee Hollow Riparian Corridor Restoration Project** (http://www.lib.berkeley.edu/WRCA/bayfund/2001_15/home.html): This site offers project information for the proposed plan to restore Tennessee Hollow Creek, one of two streams in San Francisco that have not been completely buried and built over with tall structures. The site describes the efforts of the Urban Watershed Project to restore the watershed and provides contacts for further information.
- **Orange County Coastkeeper** (http://www.coastkeeper.org/): The mission of the Orange County Coastkeeper, a nonprofit environmental activist organization, is to protect and preserve Orange County's marine habitat and watershed through education, restoration, and enforcement.
- **USDA Forest Service, Sierra Nevada Research Center** (http://www.fs.fed.us/psw/programs/snrc/water/): The Aquatic, Riparian and Wetland Ecology Group focuses on the response of populations and communities of aquatic and riparian-associated species to natural and anthropogenic influences, such as introduced exotic species, natural and regulated stream flow regimes, livestock grazing, natural and prescribed fire, and vegetation management.
- **USEPA, River Corridor and Wetland Restoration** (http://www.epa.gov/owow/wetlands/restore/): This Web site features information on restoration techniques, the benefits of restoration, information resources, and links.

- ***Integrated* Regional Wetland Monitoring** (http://www.irwm.org/): California Bay Delta Authority Science Program's Integrated Regional Wetland Monitoring Pilot Project was established to provide research related to wetland restoration in the North Bay and Delta regions of the San Francisco Estuary. In this effort, data are collected and analyzed to determine how regional ecosystems are being affected by local restoration efforts and to establish a basis for subsequent longer-term monitoring.

- **Kazmierczak, R.F., Jr., Three discussion papers on economic linkages between coastal wetlands and other environmental and recreational goals** (www.agecon.lsu.edu/faculty_staff/FacultyPages/Kazmierczak): This Web site provides links to several discussion papers that discuss the economic linkages between coastal wetlands and habitat/species protection, hunting and fishing, and water quality.

- **National Oceanic and Atmospheric Administration, National Centers for Coastal Ocean Science, *Science-Based Restoration Monitoring of Coastal Habitats*** (http://www.nccos.noaa.gov/ecosystems/estuaries/restoration_monitoring.html): This two-volume guidance is intended to help wetland restoration practitioners develop monitoring programs that can determine if a restoration project is on track and gauge how well a restoration site is functioning. Methods and tools are presented that will help practitioners coordinate monitoring programs and share results with others to improve consistency among projects. In addition to post-implementation monitoring, information in these volumes can also be used to help users evaluate the status of specific coastal habitats before restoration projects are implemented.

- **Ramsar Convention on Wetlands, *Economic Valuation of Wetlands on the River Basin Scale*** (http://www.ramsar.org/features/features_econ_val1.htm): This discussion paper addresses topics such as why it is important to estimate ecosystem value, the relationship between ecology and economics, identifying and quantifying wetland values, and using cost-benefit analysis as a tool for decision making.

2.6.4.4 Case Studies

Wetland Reserve Program Success Story. In 1989, Yolo County realtor Jeff Dyer purchased 98 acres of marginal farmland east of Zamora, California. The land had previously been used to grow rice, tomatoes, and other crops, but the heavy alkaline clay soil made farming conditions less than ideal. Dyer farmed part of the land, but he had other plans for a large portion of the property. He wanted to restore a wetland. In 1999, with assistance provided under USDA's Wetland Reserve Program (WRP), Dyer successfully restored 34 acres of seasonal marsh through a 30-year WRP easement. USDA NRCS assisted Dyer with the excavation work necessary to restore the natural hydrology of the property and improve habitat for wetland-dependent wildlife. The work included construction of shallow water areas, levees, and water-control structures. Excavation spoil was used to build levees and create islands in two of the ponds. Dyer established and maintains a variety of wetland plants and perennial vegetation that reduce soil erosion and sedimentation, improve water quality, and provide habitat for wildlife. He also installed a pump to control the water level for brood pond areas and resident waterfowl (http://www.nrcs.usda.gov/programs/wrp/states/success_ca.html).

Palomares Creek Streambank Restoration Project. The Palomares Stream Restoration Project is a joint effort by the Conservation Partnership and Alameda County Flood Control and Water Conservation District to illustrate alternative (soft) stream restoration practices. The project consists of 300 linear feet of bank protection and restoration along Palomares Creek at Palomares Elementary School near Castro Valley, California. The project demonstrates four different techniques in riparian restoration. At the most

downstream reach, a live (vegetated) crib wall has been constructed. At a large curve in the creek, toe rock has been installed. The toe rock extends into the middle reach of the root wad revetment. Lastly, at an extreme bend in an upper reach of the creek, rock riprap with joint plantings has been installed. Native vegetation will be replanted in and around the bank protection structures (http://www.baysavers.org/Programs/SLZ/restoration.htm).

2.6.4.5 References

USEPA. 2001. Chapter 5: Management Measure for Restoring Wetland and Riparian Areas. In *National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution (Draft)*. EPA 841-B-01-001. U.S. Environmental Protection Agency, Washington, DC.

Fact Sheet Links:
- Programs
- Management Practices
- Information Resources
- Case Study
- References

2.6.5 Management Measure 6C Vegetated Treatment Systems

Management Measure

Promote the use of engineered vegetated treatment systems such as constructed wetlands or vegetated filter strips where these systems will serve to reduce NPS pollution.

2.6.5.1 Programs

The Sacramento Constructed Wetlands Demonstration Project is a 5-year project of the Sacramento Regional County Sanitation District that was conducted from January 1994 to December 1998. The emphasis of the project was on describing how treatment wetlands remove trace metals (http://www.srcsd.com/cw.html).

California Buffer Initiative is an effort to encourage farmers, ranchers, and other landowners to use conservation buffers more extensively for a variety of conservation purposes (http://www.ca.nrcs.usda.gov/programs/buffer.html).

2.6.5.2 Management Practices

The practices listed below should be used where engineered systems of wetlands or vegetated treatment systems can treat NPS pollution. Vegetated treatment systems can be placed in upland regions and protect wetlands and aquatic resources from NPS pollution. For the purposes of this management measure, vegetated treatment systems are vegetated filter strips and constructed wetlands. Recommendations for installing and using vegetated treatment systems are as follows:

- Install vegetated filter strips to remove sediment and other pollutants from runoff and wastewater.
- Construct vegetated filter strips in areas adjacent to water bodies that may be subject to suspended solids and/or nutrient runoff. Key elements to be considered in the design of such areas include the type and quantity of pollutant, slope, native/non-native species, length, detention time, monitoring performance, and maintenance.
- Use vegetated filter strips to improve urban environments by increasing wildlife habitat and adding beauty to an area.
- Construct properly engineered systems of wetlands for NPS pollution control. Several factors to consider in the design and construction of an artificial wetland include hydrology, soils, vegetation, influent water quality, geometry, pretreatment, and maintenance.
- Manage constructed wetland systems to avoid negative impacts on surrounding ecosystems or ground water.

2.6.5.3 Information Resources

- ***Sustainable Conservation, Wastewater to Wetlands: Opportunities for California Agriculture*** (http://www.suscon.org/wetlands/pdfs/feasibility.pdf): This guidebook describes the use of wetlands to control pollutants in wastewater from agriculture.

- **Broome, S.W., *Constructed Wetlands for the Treatment of Storm Water Runoff*** (http://www.soil.ncsu.edu/lockers/Broome_S/vmmiller/stormwater.html): This article provides information on using wetlands to treat storm water runoff.

- **USEPA, *Guiding Principles for Constructed Treatment Wetlands: Providing for Water Quality and Wildlife Habitat*** (http://www.epa.gov/owow/wetlands/constructed/): This guidebook presents guiding principles for siting, design, construction, operation, maintenance, and monitoring of constructed treatment wetlands.

- **USEPA, *Handbook of Constructed Wetlands*** (http://www.epa.gov/owow/wetlands/pdf/hand.pdf): This is a guide to creating wetlands for agricultural wastewater, domestic wastewater, coal mine drainage, and storm water in the Mid-Atlantic Region.

- **USDA, *Constructed Wetlands Bibliography*** (http://www.nal.usda.gov/wqic/Constructed_Wetlands_all/index.html): This constructed wetlands bibliography, compiled by the Natural Resources Conservation Service and the Water Quality Information Center at the National Agricultural Library, consists of more than 600 citations.

- **USDA NRCS, Conservation Buffers Initiative** (http://www.nrcs.usda.gov/feature/buffers/): This Web site provides information on buffers, their use, and technology specifications. It describes success stories and provides links for more information.

2.6.5.4 Case Study

The Orange County Water District Constructed Wetlands Project. The Orange County Water District owns 2,150 acres behind Prado Dam in Riverside County, California. Within this area lie nearly 465 acres of constructed wetlands, which have effectively demonstrated the ability to reduce nitrogen levels in Santa Ana River. The Santa Ana River is the main source of recharge for the vast Orange County ground water basin, and consists primarily of tertiary treated wastewater from upstream dischargers. The river also receives storm flows, natural runoff, and rising ground water, especially during winter months.

The wetland consists of a system of 50 shallow ponds that have been used to remove nitrogen in river water since July 1992. The wetland system removes approximately 20 tons of nitrate a month, and during summer months reduces nitrate concentrations from 10 milligrams per liter to less than 1 milligram per liter. Several modifications have been made to increase the hydraulic capacity of the Prado wetland pond system, to handle a potential increase in future baseflows from the Santa Ana River, and to improve the operational flexibility of the system.

Prado Dam is a key component for increasing local water supplies in Orange County. Historically, storm flows from the Santa Ana River have been lost to the ocean because flood control took precedence over water conservation. However, a series of agreements between Orange County Water District, the U.S. Army Corps of Engineers, and the U.S. Fish and Wildlife Service have allowed the District to conserve water behind the dam in a seasonal storage pool. (http://www.ocwd.com/_html/prado.htm)

2.6.5.5 References

USEPA. 2001. Chapter 6: Management Measure for Vegetated Treatment Systems. In *National Management Measures to Protect and Restore Wetlands and Riparian Areas for the Abatement of Nonpoint Source Pollution (Draft).* EPA 841-B-01-001. U.S. Environmental Protection Agency, Washington, DC.

Fact Sheet Links:
- ➔ Programs
- ➔ Management Practices
- ➔ Information Resources
- ➔ Case Studies
- ➔ References

2.6.6 Management Measure 6D Education/Outreach

Management Measure

Implement educational programs to provide greater understanding of watersheds, to raise awareness and increase the use of applicable management measures and practices for wetlands and riparian areas, and to promote projects that retain or reestablish natural hydrologic functions. Public education, outreach, and training programs should involve user groups and the community.

2.6.6.1 Programs

Lake Tahoe Environmental Education Coalition (LTEEC) provides assistance to many different groups and educational organizations with educating the public about how to prevent pollution of Lake Tahoe. The University of Nevada Cooperative Extension and the University of California Cooperative Extension sponsor LTEEC (http://www.lteec.org/working_groups.php?groupID=2).

Orange County Watershed and Coastal Resources Division is progressively developing materials to better inform the public about the services that are provided. It also offers and encourages ways for the public to get involved (http://www.ocwatersheds.com/PublicEducation/pe_introduction.asp).

Adopt-A-Watershed is a K-12 school-community learning experience. Adopt-A-Watershed uses a local watershed as a living laboratory in which students engage in hands-on activities, making science applicable and relevant to their lives. It develops collaborative partnerships and reinforces learning through community service (http://www.adopt-a-watershed.org/).

2.6.6.2 Management Practices

The purpose of this management measure is to promote the establishment of programs to develop and disseminate scientific information on wetlands and riparian areas. Recommended practices include the following:

- Develop fact sheets, brochures, and flyers on the importance of wetlands and riparian areas.
- Develop greater public and agency staff understanding of natural hydrologic systems—including their functions and values, how they are lost, and the choices associated with their protection and restoration.
- Work with private landowners to encourage the preservation of wetland and riparian areas.
- Develop education programs for grade school children.
- Promote restoration of degraded wetland and riparian areas by volunteer and community groups.

2.6.6.3 Information Resources

- **Association of Wetland Managers, *Wetlands Outreach: Getting the Message Out—New Techniques and New Partners for the Millennium*** (http://www.aswm.org/propub/pubs/pdf/outreach.pdf): The report is a synthesis of two days of discussion on wetland outreach among 45 wetland outreach professionals from around the country. Participants included representatives from state, federal, and local governments as well as not-for-profit organizations.

- **The California Coastal Commission's New Science Activity Guide: Waves, Wetlands, and Watersheds** (http://www.coastal.ca.gov/publiced/pendx.html): This is a classroom and community activity guide that addresses issues such as endangered species, marine debris, coastal geology, water use, and much more. It is carefully aligned to the California State Science Content Standards for grades 3 through 8, and includes "Community Action" lessons adaptable to all ages up to and beyond grade 12. The guide is available for free from the California Coastal Commission.

- **Watershed Institute** (http://watershed.csumb.edu/): The Watershed Institute consists of a direct action community-based coalition of researchers, restoration ecologists, educators, planners, students, and volunteers. These participants all work to promote and employ a systems approach to the management of watersheds around the world.

- **The Return of the Natives Restoration Education Project** (http://watershed.csumb.edu/ron/): The Return of the Natives (RON) Restoration Education Project is a project of Creative Environmental Conservation, a 501(c)3 nonprofit. It is the education and outreach branch of the Watershed Institute of the California State University Monterey Bay. RON is a community- and school-based environmental education project dedicated to involving students (kindergarten through university) in native plant and habitat restoration projects in the schoolyard and the community

- ***University of Wisconsin* Cooperative State Research, Education, and Extension Service, Best Education Practices Project** (http://wateroutreach.uwex.edu/beps/index.cfm): The University of Wisconsin Cooperative State Research, Education, and Extension Service has initiated the Water Outreach Education project, also known as the Best Education Practices project, to help natural resource management and outreach professionals to choose appropriate education techniques and resources for their water management programs. The Best Education Practices project will work in collaboration with the federal agency clean and safe water partnership and other networks to develop and promote best education practices for water education and to improve access to education resources and strategies. Project activities reflect advice provided by federal agency clean and safe water partners and a national network of water education organizations created and supported by the work of several national organizations over the last decade. Projects have included a 2002 Study of Provider Needs, Model Education Technique, a literature search, Best Education Practices Pilot Web site, and other reference materials related to water outreach education.

- **USEPA *Watershed Academy* Web site** (http://www.epa.gov/watertrain/): This Web site offers 50 self-paced training modules that represent a basic and broad introduction to the watershed management field. The module themes include introduction/overview, watershed ecology, watershed change, analysis and planning, management practices, and community/social/water law. Several wetland-related modules are available, including "Stream Corridor Restoration Tools" (http://www.epa.gov/watertrain/restor.html), "Restoration: What's Right/Wrong With This

Picture?" (http://www.epa.gov/watertrain/frans/index.htm), and "Wetland Functions and Values" (http://www.epa.gov/watertrain/wetlands/).

2.6.6.4 Case Studies

Upper Newport Bay Project, Community-Based Restoration and Wetland Education Program. The California Coastal Commission's Upper Newport Bay (UNB) Community-Based Restoration Education Program is working to enlist community support for habitat restoration by engaging the public in hands-on restoration work and teaching them why this work is important. The program grew out of the Coastal Commission's successful public involvement efforts. The Commission's programs use a tried and true formula: collaborate with local organizations working in ecology, education, and conservation, and provide the leadership, planning, and funding to help connect volunteers and neighborhood groups with the affected ecosystem. The UNB program will serve as a model for developing coastal restoration education programs throughout California (http://www.coastal.ca.gov/publiced/UNBweb/restore.html).

Yolo Basin Foundation, Discover the Flyway Program. The Discover the Flyway (DTF) program for schools serves more than 2,500 students annually. The purpose of this program is to introduce Central Valley area teachers to wetland ecosystems and encourage class visits to the Vic Fazio Yolo Wildlife Area so they may participate in educational and interactive field studies. The DTF program includes teacher workshops, the Wild About Wetlands classroom resource kit, a lending library, classroom field trips, native grass/sedge restoration, Nature Bowl, Marsh Madness, and the Yolo Demonstration Wetlands (http://www.yolobasin.org/teachers.cfm).